Characterization and Typology of Banana Producing farms in the District of Houeyogbe in Southern Benin

ABSTRACT

Background
Banana constitutes an important crop in the tropic and participates to food security in many countries of Africa. It is widely consumed fruits in Benin. Unfortunately, the trend in yields of this crop showed a year to year decrease since 2008 to 2019 leading the production to continue falling short of demand. However, there is a paucity of information on farming systems in Benin, an important step to tackle this issue. This study aims at characterizing the types of bananas farming production systems.

Methods: We conducted structured interviews with Sixty-two (62) farmers in four villages of Houéyogbé District in southern Benin between November 2015 and February 2016. Farmers were selected randomly in each village based on the recommendation of local authorities and extension services officers.

Results
The results reveal three classes of banana farms which operate differently and have different features. Group 1 is made up of small-scale farms with low-income farmers, who did not hire labour, did not follow the agronomic production practices and did not maintain their farms. Such farms can be classed as "backyard crop garden". Group 2 includes farms with average size and income in which farmers maintain their fields, conduct inter-cropping, did not use bought planting material but sold it. Exclusively headed by men, Group 3 includes large size banana farms owners with high income who use fertilizer and maintain their farms. Area planted, seed purchase, leaf removal and system of production significantly influence income at the 1%, 1%, 5% and 10% thresholds respectively.

Conclusion
Several constraints to banana production have been identified, among which include pests and diseases, lack of clean certified planting material, land, inputs and market. In addition, there is a lack of knowledge on agronomic practices. Training on macro-propagation, agronomic practices, pests and diseases recognition with control strategy could help overcome these constraints and improve banana production in this district.

***Keywords**:* Bananas and plantains, productivity, banana farming system, banana production constraints, banana farm typology

1. INTRODUCTION

Bananas are widely consumed food in the world. It is consumed in various ways (boiled, fry, roasted) or processed as chips, flour, juice…(Dato et al., 2021). It is a staple food in some regions of Africa and is produced all year round providing food for households during the lean season (Sodédji et al., 2016). World production of bananas was estimated at 116,781,658 tons and 41,580,022 tons in 2019 respectively (FAOSTAT, 2021). Africa's production of bananas and plantains was estimated in 2019 at 21,481,876 tons and 26,705,333 tons representing 18.39% and 65.90% of the world production (FAOSTAT, 2021). In Central and West Africa, the production and marketing of bananas and plantains plays an important role in

achieving food and nutritional security while generating employment and contributing to poverty reduction (Kwa and Temple, 2019). In some sub-Saharan African countries, bananas feed more people per unit area than any other staple crop. Its production implies low production costs and is not subjected to shocks from changes in world prices, unlike crops such as rice, maize and wheat (Atkinson et al., 2015). In Benin, the production is estimated at 22284 tons for 4698 hectares of banana (FAOSTAT, 2021). Unfortunately, since 2008, the statistics reveal a decline in yields of this crop. Banana yields decreased from 53,704 t/ha in 2008 to 47.433 t/ha in 2019 (FAOSTAT, 2021). Many factors such as edaphic, agronomic and organizational can explain this decrease (Sodédji et al., 2016). According to Ferraton and Touzard (2015), it is important to set up a mechanism to identify farmers' problems and find solutions for appropriate interventions based on prior knowledge on the farming system and their realities by considering the diversity of farms. This study was carried out in order to understand the constraints that farmers face in banana production in Houéyogbé Township and to find effective solutions to tackle them. It aimed at characterizing banana production systems in Houéyogbé in southern Benin and to identify the group of farms in order to make interventions to improve productivity of banana in this area.

2. MATERIAL AND METHODS

2.1 Study area

This study was carried out in 2018 in the District of Houéyogbé located in the department of Mono in southern Benin. Houéyogbé lies between 6°20' and 6°40' north latitude and 1°45' and 1°57' east longitude, and covers an area of 320 km^2, extending 16.25 km from north to south and 13.75 km from east to west (Nangbé and Guidigbi, 2006). The climate in Houéyogbé is sub-equatorial. Houéyogbé benefits from two rainy seasons and two alternating dry seasons. The average maximum and minimum temperatures are 33.03°C and 20.74°C respectively with an average rainfall of 936 mm. Houéyogbé has a ferralitic soils, hydromorphic soils and a valley zone. These characteristics favour the development of agricultural production. Houéyogbé is characterized by 9689 agricultural households with a population of 50215 individuals (INSAE, 2016). Major agricultural products in Houéyogbé include cereals, palms, banana and plantain. The choice of this municipality is linked to its high production of bananas and plantains (Lokossou & Achigan, 2000).

2.2 Data collection

A total of 62 producers / farmers were randomly selected from four different villages namely: Doutou (11.29%), Houéyogbé (12.90%), Sê (35.48%) and Zoungbonou (40.32%). These villages were chosen based on the recommendation of local authorities according to the high production of banana. Information on the socio-economic characteristics of producers, the farming systems and the constraints they faced were collected using a structured questionnaire

2.3 Statistical processing and analysis

Data were analysed using descriptive statistics, to describe the socio-economic situation of the surveyed producers, the characteristics of their farms and their cropping and production systems. A multiple correspondence analysis followed by the hierarchical ascending clustering coupled with "k-means" was carried out to refine this description by a typology of farms. Finally, multiple linear regression was used to identify factors influencing income distribution in production. Table 1 presents the variables included in the model. Different charts and tables were presented. All the analyses were performed using R v. 3.6.1 statistical software.

Table 1: Variables used in the linear model

Variables	Description of the variables
Gender	Dummy variable=1 si male, 0=female
Age	Age of farmer (Years)
Experience	Experience in banana production (years)
Surface area	Area used for production (m^2)
Purchase of seed	Dummy variable =1 if purchase, 0=otherwise
Thinning out the leaves	Dummy variable =1 if yes, 0= otherwise
Seed sale	Dummy variable =1 if yes, 0= otherwise
Farming system	Dummy variable =1 if yes, 0= otherwise

Income	Dependent variable (US$)	

3. RESULTS AND DISCUSSION

3.1. Socio-demographic characteristics of farmers

The banana and plantain farmers lived predominantly in monogamous households (56.45%), which are majoritively headed by men (77.42%). Only 22.58% of the producers surveyed are women, 6.45% of whom are widows (Table 2). The average age of the producers surveyed was 43.73 years (42 years old for men and 49 years old for women). Less than half (40.32%) of the producers were under 40 years old. The average number of individuals living in producers' households was seven. Fifty-five percent of producers had at least a primary education level. The most educated child in the household is a boy (61.00%) and has reached at least secondary school (61.29%), while less than 40% of girls in the household attend school. Most of the farmers surveyed were natives (74.19%) of their respective villages and had practically never left the community (69.00%). Considering the experience of producers in banana production, the average was 12.60 years (Table 2). The results also reveal that a significant part of producers (64.52%) is well experienced (more than 5 years of experience) in banana production.

Table 2 : Socio-demographic characteristics of producers

Variables	Number	Percentage (%)	Means	Standard-deviation
Gender				
Male	48	77.42		
Female	14	22.58		
Marital status				
Married monogamous		56.45		
Married polygamist		29.03		
Single		6.45		
Widower		6.45		
Divorced		1.61		
Level of education				
Uneducated	22	35.48		
Literacy in local languages	6	9.68		
Primary school	15	24.19		
Secondary school	11	17.74		
Superior	8	12.91		
Age			**43.73**	**14.13**
[17-37[	17	54.84		
[37-57[	34	27.42		
[57-77[	11	17.74		
Experience			**12.60**	**10.88**
[0-6[	22	35.48		
[6-11[	16	25.81		
[11-16[	6	17.74		
[16-26[	11	11.29		
[26-46[	7	9.68		

3.2 Characteristics of the farms and constraints on production in Houéyogbé

3.2.1. Place of banana production in households

Bananas production ranks third among other cultivated food crops (Table 3) and is considered as the most important crop and being ranked first by 24.19% of producers. The main reason why producers adopted this crop in Houéyogbé is because it is a cash crop. The majority of households consume and commercialise their production for foods and financial needs. The second reason listed by farmers (35.48) was crop productivity while the market availability came at the third position (29.03%). Family decision-making regarding banana farming in the households of the producers surveyed is led by the male for the majority of respondents (61.29%). Annual income from production varies from US$ 17.94 (10,000 XOF) to US$ 5383.00 (3,000,000 XOF) (Table 3) and less than a quarter of the producers (22.58%) had an income between US$ 17.94 and US$ 71.77. Only eight producers (12.90%) earned more than US$ 897.17 (500,000 XOF). The average income earned by bananas producers in Houéyogbé was US$ 534.39 (297,822.6 XOF) (Table 3).

Table 3 : Characteristics of the farms

Variables	Number	Percentage (%)	Means	Standard-deviation
Area planted (m²)			**9046.61**	**18005.34**
[0 -1000 [	30	48.39		
[1000 - 5000 [	12	19.35		
[5000 - 10000 [	9	14.52		
[10000 - 50000 [	7	11.29		
[50000 - 100000[	4	6.45		
Rank of bananas in agricultural production			**2.94**	**1.49**
1	15	24.19		
2	8	12.90		
3	17	27.42		
4	14	22.58		
5	5	8.06		
6	2	3.23		
7	1	1.61		
Cultivation system				
Banana-manioc association	7	11.29		
Banana and sugar cane association	18	29.03		
Banana-corn and pepper association	22	35.48		
Non-associated culture	15	24.20		
Labour force				
Family	11	17.74		
Employee	51	82.26		
Temporary	40	64.51		
Permanent	11	17.74		
Sources of seeds				
Self-production of seeds	40	64.52		
Free supply of planting materials from neighbours	25	40.32		
Paying of planting materials from the neighbours	22	35.48		
Supply of planting materials on the village market	6	9.67		
Purchase of planting materials outside the village	8	12.90		
Incomes (US$)			534.39	956.82
[17.94 - 71.77 [	14	22.58		
[71.77 - 179.43 [	19	30.65		
[179.43 - 897.17[	21	33.87		
[897.17 - 1794.33[	4	6.45		
[1794.33 - 5383.00[	4	6.45		

3.2.2. Land management

The banana production area was at least 100 m² (0.01 ha) and at most 80,000 m² (8 ha). Only 17.75% of the producers had an area of 10000 m² (1 ha) of banana plantation and were only men (Table 3). The maximum area held by women was 0.8 ha and mostly obtained via rental, purchase or inheritance. Purchasing is the second most common method of land acquisition (30.65%) and one farmer can hold up to four plots. Only 21.00% of them hold more than one plot, most of which are at various spots.

3.2.3. Banana growing system

Result revealed that most of the bananas producers adopt the system of inter-cropping on their farms (75.80%) (Table 3). This represents 79.16% of the men and 64.28% of women. Crops inter-cropped were maize and chilli (35.48%), sugar cane (29.03%) and cassava (11.29%). In that system, women gave priority to maize and chilli pepper, while men gave priority to maize, chilli pepper and sugar cane. This trend can be explained by the fact that maize and chilli are staple foods for the population in Benin, whereas sugar cane is a cash crop grown mainly for commercialization. The majority of producers (45.16%) grew plantain. The main reason for 77.42% of plantain production in this area was its demand. The availability of the local and neighbouring markets is the main determinant in the choice of plantain production in this area. It is worth to mention some characteristics influence the choice of varieties to be produced. These characteristics are taste (46.77%), high yield (22.58%), processing quality (20.97%), and short cycle (12.90%) (Fig. 1).

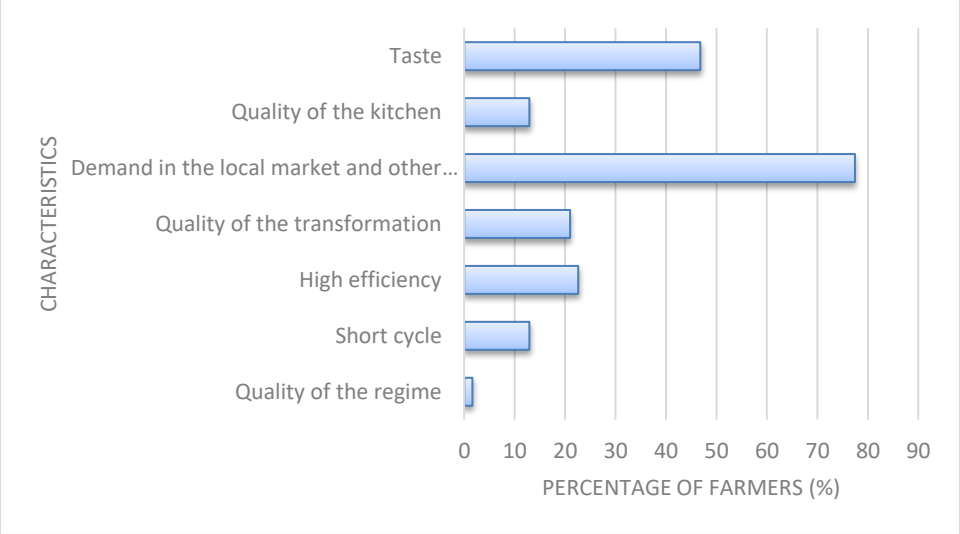

Figure 1: Characteristics sought on bananas

3.2.4. Labour for production

All farming activities are carried out by 17.74% of producers using family labour (Table 3). Men constitute the most used agricultural labor force for all types of activities. Women were most involved in activities such as fetching plant materials, harvesting, transporting for marketing and strip off the leaf. In general, young boys were more involved in mulching, transporting suckers and fruits/bunch. As for girls, they were more involved in transporting food for consumption. Hiring labour was mainly used by 82.26% of producers for: soil preparation, planting, weeding, mulching and pesticide application when applicable. Producers often use casual for labour (64.51%).

3.2.5. Sources of planting material and technical support

Planting material used for production come from a various sources. The same producer may have multiple sources (Table 3). Most producers (64.51%) used planting materials from their own fields, some from their neighbours free of charge (40.32%) or with a lump sum (35.48%). Meanwhile others collected from local markets (9.67%) and/ or outside the village (12.90%). As far as technical assistance is concern, 92.00% of producers said they received no technical support on banana agronomic practices. Fortunately, some farmers revealed that there was knowledge exchange. However, there are exchanges of knowledge between themselves and project on diseases, symptoms and control measures.

3.2.6. Analysis of constraints

According to some farmers (33.87%), the most important constraints are banana diseases and pests and the unavailability of clean seeds (17.74%) (Table 4). In addition, lack of inputs (12.90%), limited access to land (11.29%), unavailability of market at all times (8.06%), high cost of inputs when available (6.45%), slump due to low farm-gate banana prices (3.22%) proposed by customers, the lack of credit (3.22%), the lack of technical support (1.61%) were also constraints limiting the production. Fields observation revealed that 54.84% of the producers surveyed were confronted with Banana Bunch Top Disease (BBTD).

Table 4: Constraints related to banana production in Houéyogbé area

Constraints	Percentage (%)
Diseases and pests	33.87
Limited access to land	11.29
High input costs	6.45
Lack of input	12.90
Lack of clean seeds	17.74
Low field edge price	3.22
Market unavailability	8.06
Lack of funding	3.22
Pouring	1.61
Lack of technical support	1.61

3.3 Conventional and organic production systems and determinants of production income

Most banana producers in Houéyogbé (80.65%) were involved in organic farming (Table 5). Only 19.35% of the producers used NPK, chemical fertilizers in their production system. Very few producers (12.90%) use chemical pesticides the production system. The average banana production per farm in Houéyogbé was estimated at 1,489.11 kg. The average yield is 8.79 t/ha, with a significant difference at the 1% threshold between the organic production system (5.81 t/ha) and the conventional production system (21.21 t/ha). The average annual income per hectare is US$ 3154.37 (1,757,962 XOF). This is significantly higher at the 5% threshold for producers using a conventional production system US$ 7,613,24 (4,242,933 XOF) compared to those not using chemical inputs US$ 2084.24 (1,161,570 XOF). From all the initial explanatory variables, only area, seed purchase, leaf removal and production system significantly influence income at the 1%, 1%, 5% and 10% thresholds respectively (Table 6).

Table 5 : Conventional and organic production system and annual income per hectare

Variables		
Qualitative variables	**Number**	**Percentage (%)**
Use of chemical pesticides	8	12.90
Use of chemical fertilizers (NPK)	12	19.35
Farming Systems		
Conventional	12	19.35
Organic	50	80.65
Quantitative variables	**Means**	**t-Statistic (p-value)**
Average production (kg)		
Conventional	4650.00	
Organic	730.50	
All	1489.11	t=-5.59 (p=0.0000***)
Yield (t/ha)		
Conventional	21.21	
Organic	5.81	
All	8.79	t=-3.34 (p=0.0013***)
Income per hectare per production system (US$/ha)		
Conventional	7613.24	
Organic	2084.24	
All	3154.37	t=-3.36 (p=0.0014***)

Table 6: Factors influencing income (logarithm of income) from banana production

Variables	**Coefficients**	**Erreur-standard**	**T-Statistic**	**P-value**
Intercept	10.07	0.39	25.705	2.0 E-16***
Farming system	0.77	0.40	1.94	0.057.
Area	2.69 E-5	9.07 E-6	2.969	0.00436**
Purchase of seeds	0.76	0.275	2.752	0.00793**
Stripping of leaves	1.074	0.407	2.635	0.01082*
Multiple R-squared	0.5138			
Adjusted R-squared	0.4797			
F-statistic	15.06			
Akaike Informative Criterion (AIC)	1.3217			
Shapiro-Wilk normality test W = 0,9583				0.03395*
Rainbow test Rain=1,1855				0.3314
Goldfeld-Quandt test GQ = 1,408				0.1943
Durbin-Watson test DW = 2,0346				0.5193

Variance Inflation Factors (VIF)	
VIF_Farming System	1.607
VIF_ Area	1.723
VIF_ Purchase of seed	1.086
VIF_ Stripping of leaves	1.092

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

3.4. Typology of banana-producing farms

After a multiple correspondence analysis (MCA) (Fig. 2) followed by a hierarchical clustering consolidated by the K-means method (Figure 3), three groups of banana farms were identified. The first group, on the left above axis 1 and comprising 11.29% of the farms (Fig. 2), is made up of farms with a small area, low income, not using casual and not following the agronomic practices (labour, soil preparation, sowing, weeding and fertilization) in their farms (Fig. 2). All the individuals (100.00%) in class 1 have an area of less than 1000 m², do not carry out field fertilization and rank bananas third. Three-quarters (75.00%) of these individuals have an income of less than US$ 897.17 and half have an income of less than US$ 71.77. Individual 9 represents the paragon of this class (individual in the centre of the class) and individual 51 is the most characteristic or representative of this class (Fig. 3).

The second group includes most (70.96%) of the farms. It includes farms using less than one hectare who practiced leaf stripping, mulching, soil preparation, weeding, seeding and intercropping. Most of farmers had only one field did not buy seed but sell it (Fig. 2). Eighty seven point fifty percent (87.50%) of the farms with an income between US$ 71.77 and US$ 897.17 belong to this group as well as 78.00% of them that practiced weeding and soil preparation belong to this class. The farms (100.00%) had a size between 1000 and 10000 m² belong to this class. The majority (81.00%) of farmers in class 2 had an income between US$ 71.77 and US$ 897.17. All the farms in this group (100.00%) carried out soil preparation and weeding. Individual 5 represents the paragon of this class and individual 23 is the most characteristic of this class (Fig. 3).

The third group located on the right above axis 1 and comprising 17.14% of the farms, includes farms having of 3 to 4 plots with an area between 1 and 13 ha. Some of them did not practice stripping of leaf or mulching but bought seed/plant material (Fig. 2). Their (100.00%) income lies between US$ 1794.33 and US$ 5383,00 and mostly represented by men. In this class, 83.00% of farm owned three plots. Majority of farmers (91.00%) used fertilizer, and chemical inputs. At least 63.60% had an area between 1 and 5 ha. Individual 45 is the paragon of this class and individual 62 is the most characteristic of this class (Fig. 3).

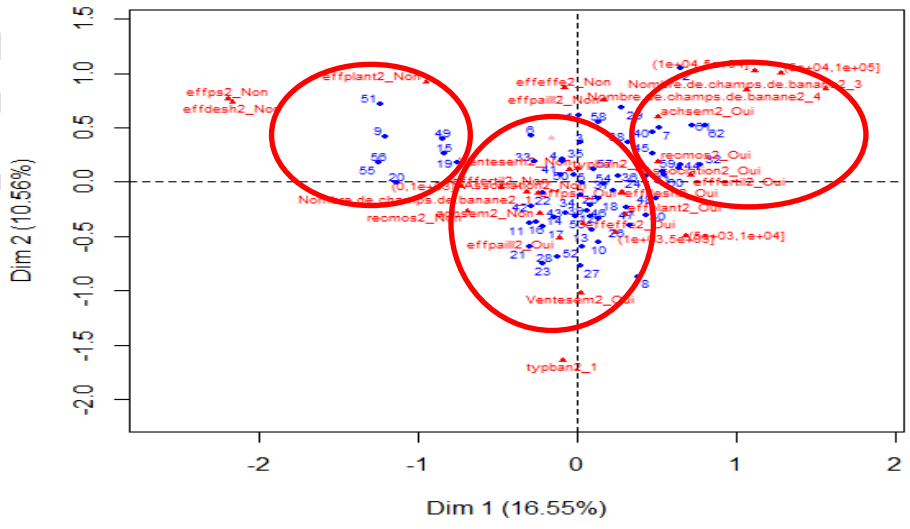

Figure 2: Representation of active modalities and farms on axes 1 and 2 using a factor map

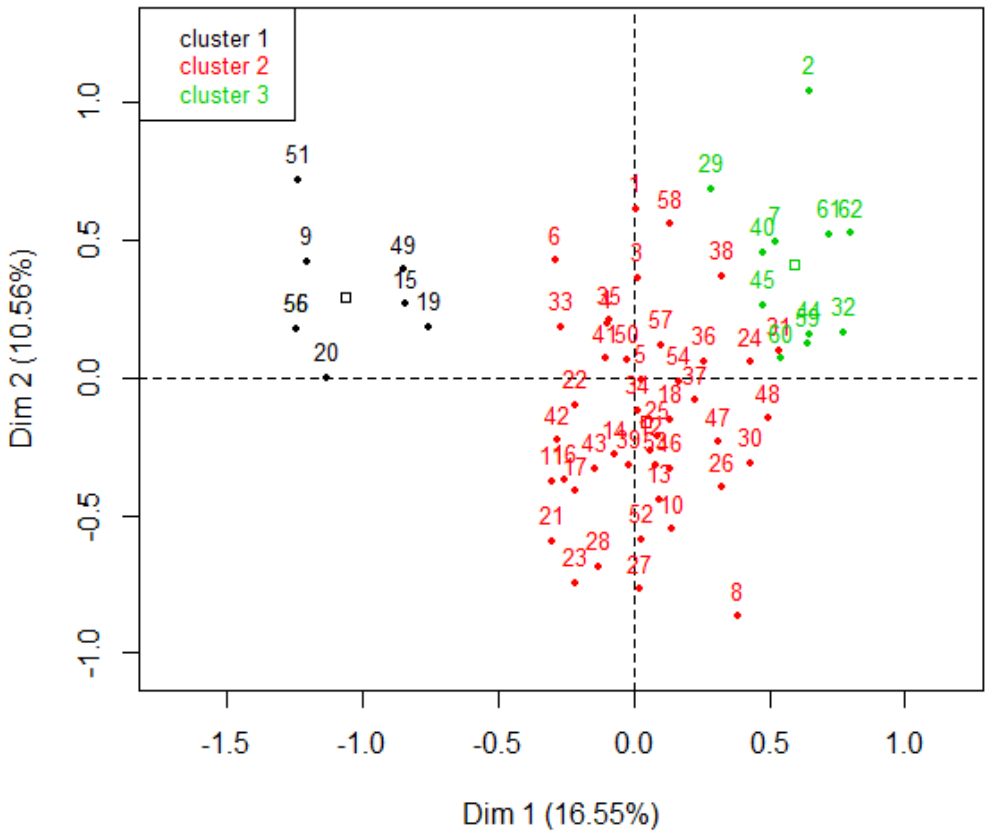

Figure 3: Representation of the farm groups on axes 1 and 2 using a factor map

4. Discussion

The characterization of banana and plantain production farms in the commune of Houéyogbé reveals that men are dominant (77.42). The high percentage of men involved in this activity is explained by the fact that bananas production requires several farming steps and significant muscular efforts. Men are considered as heads of households and are decision-maker therefore capable of meeting all the requirements involved in this activity. Although different generations of producers are engaged, youth are more involved in the production. The rate of young people under 37 years is higher than that found by Mialoundama Bakouétila et al. (2016) in Mouyondzi district in Congo and Adigbonon et Allagba (2015) in Akpro-Missérété and Adognon et Medenou (2015) in Adjarra in Benin. This might be explained by the fact that most people engaged in the production are native from the communes and no much smuggling in fuel business as it happened in Adjarra. The survey showed also that most of youth who travelled out usually returned to their respective villages to capitalize experiences gained elsewhere. More than 50% of those

farmers are educated. This number is less than those reported in Congo by Mialoundama Bakouétila et al. (2016). Education being an important pillar, it could be critical in production improvement and adoption of technological innovations. Banana production is ranked first by 24% of them. This proportion is generally low compared to other locations (Mialoundama Bakouétila et al., 2016). Indeed, Congo as well as Cameroon are Central African countries, an area reputed to be a major producer of banana and plantain compared to Houéyogbé where production has just started to emerge. Bananas are in most cases associated with food crops (Temple et al., 1993; Mialoundama Bakouétila et al., 2016).

This is understandable as land availability is recognized to be a limiting factor in some areas and farmers driving force include opportunity cost. Looking at banana production cycle, they prefer taking in account other crops to get income and cover the family needs before the harvesting time of the fruits. Again, diseases and pests are the primary factors limiting banana production. Pouring observed among bananas farms in Houéyogbé, could be a consequence of climatic changes. With the impact of climate, many diseases emerged or there is an outbreak of known diseases and pests. Majority of producers in this area obtain their planting material from their own farms or neighbors. As the distribution system of planting material is even the heart of any production system, there should be a better way to improve the seed flow system and discourage farmers from this tradition, knowing that this tradition can explain why disease spread (FAO, 1989). It is easy in this situation to justify the high prevalence of diseases and pests, more specifically the BBTD responsible for production losses in that commune and in other communities where losses up to 100% were recorded Sodédji et al. (2016) making households vulnerable. This disease has been observed in more than 50% of the producers surveyed who have little knowledge of its symptoms, means of transmission and control methods. The lack of technical assistance can justify why farmers have no knowledge about the diseases. It is worth to mention that banana were one of the ‘motherless’ fruits although its uses in Benin.

Knowing that knowledge on disease diagnosis and management is a very important parameter for effective disease and pest control (Abiola et al., 2019; Blomme et al., 2014; Zandjanakou et al., 2009), there should be an urgent program of training to these farmers. Moreover, according to Atkinson et al. (2015), the effectiveness of support to agricultural innovations necessarily depends on the recognition of farmers' needs, widely available and affordable planting materials, the dissemination of knowledge for their effective use and access to markets. Although banana and plantain production were considered as backyard crops in Benin, it contributes significantly to household food security (Sodedji et al., 2016). Bananas are highly valued by consumers and are subject to diverse market transformations.

The analysis of typology in the banana production systems in the commune of Houéyogbé has shown that there is a diversity of banana production systems. They are distinguished by the banana cultivated area, income, use of casual, field fertilization, field maintenance, cropping system and agronomic practices. The first category is made up of farms practicing traditional banana production, without maintenance and without sowing, using suckers from the mother plants suckers from the plant. Banana production in Benin is for the most part traditional and is carried out on very small areas (Adigbonon and Allagba, 2015). These are the hut orchards (CTA, 2012). For these farms, the banana plants are often in tufts, a technique that is used in Cameroon according to Temple et al (1993) to increase the resistance of the mother plant to the falling phenomenon and to spread production over the year, providing them with a regular income. These types of farms that use so-called “food-producing” strategies are described as “hut plantation” with characteristics similar to those of the commune of Houéyogbé. Their cropping system is described as "extensive monoculture" where the farmer does not use inputs, an irrigation system and selected varieties (Mialoundama Bakouetila, 2016). According to the same author, producers use this cropping system in order to sustainably manage their farms and maintain their livelihoods. In Benin, this system of production was common as the fruit were not so valuable. An improved form of "hut orchards", but still traditional characterizing the farms in the second group are in an intermediate situation compared to those in classes 1 and 3, particularly in terms of area cultivated and income from the sale of bananas. However, its characteristics are closer to those in group 3. In contrast to group 1, they are into intercropping and follow agronomic practices. They use subsistence strategies where the producer gives priority to food self-consumption.

The surplus is then marketed, providing them with permanent income, enabling them to meet the family's needs (Mialoundama Bakouetila, 2016). Moreover, the production is in sparse clumps associated with a few food crops including macabos in Cameroon (Temple et al., 1993). This is in contradiction with the plantations in Cameroon that use same strategy, have a larger surface area of 1 to 4 ha, unlike those in the commune of Houéyogbé, where they have less than 1 ha and more than 1000 m²

The surplus is then marketed, providing them with permanent income, enabling them to meet the family's needs (Mialoundama Bakouetila, 2016). Moreover, the production is in sparse clumps associated with a few food crops including macabo (Temple et al., 1993). This is in contradiction with the plantations in Cameroon that use same strategy, but have larger farm size The farmers in this group seem to be better off as far as engagement is concerned.

Generally larger, and more engaged in banana production as their main activity, the farms in the group 3 are characterized by a large production area and high income in comparison to others. The size of the farm, the income as well as the agronomic practices carried out show the beginning of specialization in banana production by this category.

Most of them use chemical fertilizer that lead to high yields (21,21 t/ha in average) compared to the two others clusters. However, these yields are lower than those recorded in Ivory Coast by N'Guetta et al. (2015) that achieve 38.1 t/ha. The characteristics of these farms are similar to those of plantain producers in Cameroon who implement the business strategy and who own an area of more than 4 hectares of banana trees (Temple et al., 1993). The yield could increase if technical assistance is given. Most producers do not use chemical (chemical fertilizers and chemical pesticides) in production. This is an environmental advantage at the community level but that does not allow them to be competitive compared to those who use chemical inputs in production. They obtain an average yield of 5.81 tonnes per hectare while those using chemical inputs have an average yield of 21.21 t/ha. The yields obtained in so called 'organic banana production' in Houéyogbé are comparable to those reported by Nkapnang Djossi (2011) and those of Nkendah and Akeyeampong (2003) on banana production in tropical Africa.

According to Nkapnang Djossi (2011), banana yields are 5.4 t/ha, 7.6 t/ha, 5.1 t/ha, 2.9 t/ha, 4.4 t/ha, 11 t/ha and 6 t/ha for Cameroon, Republic of Congo, Equatorial Guinea, Central African Republic, Democratic Republic of Congo, Ghana and Nigeria respectively. Yields estimated by Nkendah and Akeyeampong (2003) were 7.0 t/ha, 16.6 t/ha, 4.6 t/ha and 8.1 t/ha respectively for Ghana, Cameroon, Gabon and Côte d'Ivoire. Knowing that banana production in tropical Africa is generally carried out in a traditional way with an extensive system, which does not allow yields in the order of 30-40 t/ha compared to research stations and agro-industries data (Kwa et al., 2005; Nkapnang Djossi, 2011; N'Guetta et al., 2015). It is worth to mention that intensification of production is necessary to achieve higher yields. However, it is important to provide guidance to producers on the use of inputs in order to not damage ecosystems following this intensive use of chemical pesticides and fertilizers. Leaf stripping is a practice that positively influences the yield and income of banana producers in Houéyogbé. Leave stripping is a technique that removes leaves with necrosis and significantly reduces the amount of inoculum and control spp. (Dural and Foure, 2011) In case of disease control such as Sigatoka disease, farmers use mechanical control that is not effective when used in a random way. Another control strategy consists in using herbicide. Gomez Balbin and Castano Zapata (2001) after their work on integrated pest management (IPM) of cercosporiosis in bananas report that IPM including leaf stripping provides effective control of the disease. Leaf stripping outside the control of cercosporiosis results in photosynthetic efficacy on the rest of the leaves present on the banana tree (Blomme et al., 2001). The results of the present study indicate that banana and plantain in Houéyogbé are not efficient and not competitive. There is a need to support producers by providing them with new techniques and tools to improve their productivity and income.

5. CONCLUSION

The temporal evolution of cultivation practices in the banana sector has led to the identification of three types of banana-producing farms. They are distinguished by the practice of cultivation activities, the use of inputs, the use of paid labour, the area sown, the cropping system, and the income. Some are purely traditional (hut orchards), others are intermediate and some are tending to modern (more market-oriented). These characteristics and specific operations to each group do not spare them from constraints that hinder the development of this sector. They are essentially related to diseases and pests, particularly Banana bunchy top disease (BBTD), which causes significant economic losses and threatens household food security. The non-availability of healthy plant materials, which implies the use of seeds from dubious sources, is a means of spreading diseases. However, in this Township, there is no technical assistance on banana production, on diseases recognition and their management although this knowledge was very important parameters for good production. Moreover, there was a lack of control of agronomic practices

for banana production. It is urgent at the level of agricultural policy to encourage initiatives to promote the expansion of its production. Thus, training on macro propagation to obtain healthy plant materials, on banana agronomics practices, on recognition and control of diseases and pests could improve the production in the area. Also, training specific to each category of farm could help them maximize their productivity.

REFERENCES

1. Abiola, A., Zandjanakou-Tachin, M., Aoudji, KNA, Avocevou-Ayisso, C. & Lava Kumar, P., 2019. Adoption of Roguing to Contain Banana Bunchy Top Disease in South-East Benin: Role of Farmers' Knowledge and Perception. International Journal of Fruit Science, DOI: 10.1080/15538362.2019.1673277
2. Adigbonon, M.M. & Allagba, I.T., 2015. "Diagnostic study of the banana and plantain production system in the commune of Akpro-Missérété". License dissertation, University of Agriculture of Kétou, Kétou, Benin.68p.
3. Adognon, A. & Medenou, Y.E., 2015. "Diagnostic study of the banana and plantain production system in the commune of Adjarra". License dissertation, University of Agriculture of Kétou, Kétou, Benin.61p.
4. Atkinson, H.J., Roderick, H. & Tripathi L., 2015. Africa needs streamlined regulation to support deployment of GM crops. Trends in Biotechnology, 33 (8), 8. DOI: 10.1016/j.tibtech.2015.06.005
5. Blomme, G., Tenkouano, A. & Swennen, R., 2001. Influence of leaf stripping on the growth of banana stems and roots (Musa spp.). Africa. Infomusa, 10(2), 10-13
6. Blomme, G., Jacobsen, K., Ocimati, W., Beed, F., Ntamwira, J., Sivirihauma, C., Ssekiwoko, F., Nakato, V., Kubiriba, J., Tripathi, L., Tinzaara, W., Mbolela, F., Lutete, L. & Karamura E., 2014. Fine-tuning banana Xanthomonas wilt control options over the past decade in East and Central Africa. Eur J Plant Pathol, 20p. DOI: https://dx.doi.org/10.1007/s10658-014-0402-0
7. CTA, 2012. State of the fruit sector in Benin. CTA – Gret – TPA network, 11p.
8. Dural, D. & Foure, E., 2011. Sigatoka: mechanical sanitation, Tropical Technical Institute (IT2), Technical Note, Center for International Cooperation in Agronomic Research for Development (CIRAD), 2p.
9. FAO, 1989. Roots, tubers and plantains in food security: in sub-Saharan Africa, Latin America and the Caribbean, and the Pacific. FAO Economic and Social Development Study, 75p.
10. FAO, 2014. Banana and plantain production in 2014. http://www.fao.org/faostat/en/#data/QC.
11. FAOSTAT, 2021. Food and Agriculture Organization of the United Nations. http://www.fao.org/faostat/en/#data/QC. Consulted on March 21, 2021
12. Ferraton, N. & Tourard, I., 2015. Understanding family farming: Diagnosis of production systems. Editions Quae, CTA, Presses agronomiques de Gembloux, 123p.
13. Gomez Balbin, L.A. & Castano Zapata, J., 2001. Integrated management of black and yellow Sigatoka diseases in the plantain variety cv.Africa. Infomusa, 10(2), 3-7
14. INSAE, 2016. Notebooks of the villages and city districts of the Mono department, Republic of Benin, https://www.insae-bj.org/images/docs/insae-statistiques (September 2019)
15. Kwa, M., Pefoura, A.M. & Akyeampong, E., 2005. Cultivation of plantain at high density in Cameroon, African Crop Science Conference Proceedings 7, 51-53.
16. Kwa, M. & Temple, L., 2019. The plantain banana, socio-economic and technical issues. Agricultures Tropicales en poche, Quae, CTA Presses Agronomiques de Gembloux, 199p.
17. Lassoudière, A., 2007. The banana tree and its cultivation. Versailles: Ed. Quae, 383 p. (Know-how) ISBN 978-2-7592-0046-7
18. Mialoundama Bakouétila, GF, Boukoulou, H., Tchouamo, IR, Mbemba, F., Koussafoula, E., Petit, S. & Mboungou, Z., 2016. Banana (Musa sp.) production in the Mouyondzi district ,

Republic of Congo. Journal of Animal & Plant Sciences, 2016, 30 (1), 13p. http://www.m.elewa.org/JAPS
19. Nangbé, F. & Guidigbi, E. 2006. Monograph of the commune of Houéyogbé. Africa Council, Ministry of Decentralization, Republic of Benin, 43p.
20. N'Guetta, A., Traore, S., Yao, NT, Aby, N., Koffi, YD, Atsin, GO, Otro, STV, Kobenan, K., Gnonhouri, P. & Yao-Kouame, A. 2015 Incidence of planting density on plantain growth and yield in Côte d'Ivoire: case of two hybrids (PITA 3 and FHIA 21) and two local varieties (Corne 1 and Orishele). African Agronomy, 27(3): 213–222
21. Nkapnang Djossi, I., 2011. Identification and optimization of the conditions for the appropriation of banana and plantain innovations by producers in Cameroon. Doctoral thesis, Catholic University of Louvain (UCLouvain), Louvain-La-Neuve, Belgium, 155p.
22. Nkendah, R., Akeyeampong, E., 2003. Socio-economic data on the plantain sector in Central and West Africa. Infomusa 12 (1), 8 - 13.
23. Sodédji, F., Dossou, L., Zandjanakou-Tachin, M., Avocevou-Ayissoh, C., Capo-Chichi, E., Gnacadja, G., Tcheho, J., Kumar, L. & Zinsou. V., 2016. Midterm report of banana bunchy top virus control strategies in two communities (Akpro-Missérété and Adjarra) in Benin Republic, Annales de la Faculté des Lettres, Arts et Sciences Humaines, 2 (22)? 312-321.
24. Temple, L., Genettais, T., Ganry, J., Chataigner, J., 1993. Plantain production systems and prospects for intensification in southwestern Cameroon. Fruits, EDP Sciences/CIRAD, 48 (2), 119-123.
25. Zandjanakou-Tachin, M., Ojiambo, P., Tenkouano, A., Gumedzoe, Y.M.D. & Bandyopadhyay, R., 2009. Identification and genetic diversity of Mycospha